

## Evaluating the Perennial Flooding on the White Volta River and the Bagre Dam Spillage on Agricultural Activities in the Sudan Savanna in the Upper East Region, Ghana



John Aloba Atubiga<sup>1</sup>, Alobit Baba Atubiga<sup>2</sup>, Lincoln Tei Nyade<sup>3</sup>, Eric Donkor<sup>4</sup>

<sup>1,3,4</sup>Department of Geography and Resource Development, University of Ghana, Legon.

<sup>2</sup>Department of Hospitality and Tourism Management, Tamale Technical University, Tamale, Ghana

**ABSTRACT:** Ensuring food security and the reduction of poverty has become a major challenge for sub-Saharan African countries especially among subsistent farmers. Subsistent households depend on the yield obtained from the farm for their survival and economic development. However, the nature and impact of the floods have increased in frequency and intensity especially in recent years which have affected food production. It is against this background that this study was undertaken to evaluate the perennial flooding the White Volta River and the Bagre Dam spillage on agricultural activities in the Sudan Savanna in the Upper East Region of Ghana. The mixed method design was employed for the study which obtained information on both qualitative and quantitative data about the issue under investigation. A total of 200 subsistent farmers households were randomly sampled for the data collections. The primary data was collected using questionnaires, interviews, focus group discussions, field observation and photography. The secondary data was obtained from NADMO and MOFA directorates on the destruction of farms and crops yields respectively.

The findings show that the study areas experience floods every year. The floods usually occur around August and September when rainfall is in torrential coupled with the spillage of the Bagre dam. The flooding has resulted in the declined in food production among subsistent farmers. As a result of this, households in Galaka, Salipiga, Yarigu, Binduri and Sapkare were food insecure. This situation (food insecurity) has led to households engaging in others activities in ensuring food security. The study recommend that there should be close engagement between authorities in Ghana and that of Burkina Faso so that the latter country can provide exact time for the spillage of the dam. Information on the dam spillage beforehand will help farmers in the affected communities to adequately prepare, including early harvesting to reduce the amount of farm produce lost to floods.

**KEYWORDS:** Flooding Bagre dam torrential subsistent farming food security

### INTRODUCTION

Sustaining food security at the global and household levels has been identified as a major challenge for many nations more especially developing countries. The Food and Agriculture Organization (2012) estimated that between the periods of 2010-2012, about 870 million people were identified to be undernourished. The figure represented 12.5% of the total global population. Majority of these people (852 million) were found to be in developing countries. In sub-Saharan Africa, the issue of food insecurity and malnourishment have increased since 1992 and it is estimated that by the year 2030, the region will be a home to about 30 percent malnourished people (FAO, 2010).

In Ghana, the reduction of poverty and the achievement of sustainable food security are major challenges facing the country (Devereux & Maxwell 2001; Challinor et al. 2007). The country has in past years experienced intermittent food insecurity. For instance, in 1981, Ghana was among twenty four countries in sub-Saharan African that were facing critical food security as a result of drought and flood and were in dying need of food aid (McCarthy 1986). According to Quaye (2008) households could not access food in adequate quantities which were sufficiently and safe for a healthy life.

Although the country has witnessed a drastic decreased in food insecurity, hunger and starvation continues to persist more especially in the northern part of the country due to unstable crops production, low income and poor yields as a result of annual floods (FAO 2010). Recent studies in the region have revealed changes in temperatures are expected to increase by the year 2030

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(McSweeney et al. 2010; Van de Giesen 2010; CDKN 2014). This will lead to increase in annual floods which poses a potential threat to food security in the area (Laube et al. 2012).

Almost, all agricultural activities in this part of the country are rainfed (Tuor, 2017). With the rise in temperatures and its related weather extremes such as the occurrence of floods, the influence of this on crops production and yields are projected to be severely affected. The consequences of this on household food security is expected to be under threat since about 55 percent of the population directly depend on agriculture for their source of livelihoods and contributes about 39 percent to the Gross Domestic Product (GDP) (Ghana Statistical Service 2012; MOFA 2015).

Food production in this area is projected to depend more on climate than it was 200 years ago (FAO, 2017). This increased in climate variability will expose farmers to the risk of frequent flooding and this will lead to crops failures (Andreini *et al.* 2000; Laube, Leemhuis & Amisigo 2008). Thus, the possible effects of floods on crops production need to be given more attention since this phenomenon can jeopardize the food security in the area (FAO 2008).

The Bawku West and Binduri Districts are located in the Sudan Savannah Ecological zone. Their locations make them prone to multiple hazards (Yiran & Stringer, 2016) of which flood is a major issue. The main causes of the flooding is torrential rainfall leading to the White Volta overflowing its banks and also the spillage of excess water on the Bagre reservoir upstream of the river (Forkuo, 2011) which normally coincides with the period of heavy rains. Flood occurrence and destructions has become an annual event in the district responsible for on farm and post-harvest damage threatening food security in the area. For instance, within five-year period (2007 – 2012), the district was struck by four major and several minor flood events (Musah et al., 2013) with farm lands destroyed and tender crops submerged in water. The Ministry of Food and Agriculture (MOFA) assessment of the 2007 flood in the district revealed that about 30,500 hectares of farm lands were destroyed, leading to an estimated yield loss of about 144,000 metric tonnes of food crops (Musah et al, 2013). This resulted in acute food shortage in the affected communities making them vulnerable to food insecurity (Frederick, et al. 2010).

It has been established that present and successive governments have been assisting affected households with relief items and shelter (Sidibe, Williams & Kolavalli, 2016) but this usually take the form of blankets, buckets, mattresses which have no correlation with their food security. In instances where food items are provided, it cannot make up for what is already lost to the flood (Braun, 2008; UN; 2011). According to Schraven (2010) the food items provided are not adequate to sustain the affected families thus, endangering the food security in the area.

Despite the high impact of flooding on the food security in the area, several studies in the zone (Blench, 2007; Frederick et al., 2010; Musah et al, 2013; Sebastian, 2014; Sidibe et al, 2016) have been interested in investigating the impact of the flood on the environment, ecosystem and livelihood changes of the people. These research tend to neglect the issue of food security which is essentially the backbone of every household survival and the achievement of Sustainable Development Goal 2 of ending hunger. Research which tends to include food security are skewed to drought studies on food security. More studies need to be conducted to ascertain how torrential rainfall couple with the annual Bagre dam spillage resulting in flooding is affecting food security in the area. Also, there is the need to understand the coping strategies of the households toward ensuring food security as about 70% of the population source of livelihood depends on the produce from the farm (Debile et al., 2016). This study fills the knowledge gap by investigating the impact of the flood on food security in the Bawku West District in the hope of realizing the United Nation SDGs goal 1 and 2 of reducing poverty and ending hunger by the year 2030.

### **METHODOLOGY**

#### **Research design**

The study adopted the mixed method approach since it has been widely used in recent time was adopted for the study (Tashakkori & Teddlie, 2010). Although the mixed method has its own differences in epistemological background, the approach is scientific and good for its applicability in different spheres of human livelihoods like food security (Bryman, 2001). For instance, the mixed method approach was used by Acquah to analyze the 2015, June 3<sup>rd</sup> Twin-Disaster in Accra, Ghana in which he said using the mixed method approach in a single study provides an in-depth information in order to arrive at a reliable and a valid conclusion (Acquah, 2017). The quantitative approach which uses research instruments like the survey was applied in collecting data about the levels of households' food security and their adaptive strategies applied during period of food insecurity. On the other hand, the qualitative approach which uses research instruments such as interview and focus group discussion were applied in collecting data concerning the causes, period and duration of the flood. Also, the farming practices adapted by farmers to ensure food security and their level of sustainability were equally explored.

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## Sampling

The non-probability sampling (purposive sampling) technique was employed to select the communities which engage in farming activities along the White Volta basin. They were purposively sampled because of their high level of susceptibility to the annual floods and the level of damage usually caused by the flood to their farm lands and animals. Table 1 shows the communities selected for the study in the two district.

**Table 1. Communities selected for the study in the two district**

S/N	District	Community	Sample size
1	Bawku West District	Salipiga	41
		Yarigu	38
		Galaka	39
2	Binduri District	Binduri	45
		Sakpari	37

Source: Field work (2019)

A total of 200 households were selected for the study using simple random sampling as shown in Table 1 above. Armah et al (2010) have revealed that for effective research to be conducted in the social science field, the sample size should be representative enough to ensure effective interaction and also easy handling of the data. The simple random sampling was use because it eliminates biases and brings about generalization.

An in-depth interview was conducted as part of the data collection with District NADMO coordinators in both districts on how the flood is affecting food security, and effectiveness of the assistance from NADMO in ensuring food safety. Also, MOFA directors in the districts were equally interviewed to ascertain how the flood is affecting farming activities in the districts and the effectiveness of the relief items provided by NADMO.

Five focus group discussion were organized in the study communities with each focus group comprises of 6 to 8 participants for effective discussion on issues of flooding and food insecurity. This number is recommended by Bryman (2004) for effective discussion. The purpose of the Focus Group Discussion was to interact with the participants and obtained information that were not made available in the survey.

## Data analysis

The data was analyzed qualitatively and quantitatively and integrated to suit the purpose of the study. In analyzing qualitative data, Bond (2006) provides a three-way stages which is; data description, classification and connection and this was followed in analyzing the data obtained using the qualitative research instruments.

The in-depth interviews and focus groups discussions were transcribed into English. Also, observation notes were recorded in the form of a research diary. The data was then sift and sorted into meaningful classification as revealed by Bond (2006). A coding system was developed for the data. After the coding was done, the data was put into themes in relation to the issue under investigation. Observational notes were also coded and put into themes.

The data obtained from the questionnaires administered to the household respondents about the impact of the flood on food security was cleaned to correct the few mistakes which were discovered when the questionnaire were being filled. After the cleansing of the data, it was coded and put into Statistical Package for Service Solution (SPSS) version 21. It was then analysis to create a percentage of the responses and produced a descriptive image about the data acquired on the themes. The information was then presented in frequency tables, graphs etc.

## RESULTS AND DISCUSSIONS

This section presents results and discussions of the study. The first part of the section presents trend on flooding including the spatial coverage and temporal dynamics of the floods situation. The subsequent section presents information on the impact of flooding on food production and the coping mechanisms of household in dealing with floods.

### Rainfall patterns and its linkage with floods in the study communities

Flooding is largely caused by hydrological factors, albeit exacerbated by human induced factors. In ascertaining the trends in flooding in the study communities, information was obtained from NADMO office about the flooding situation in the area. Also, rainfall data over the period of 2007 to 2018 was obtain to corroborate the information provided by NADMO. The rainfall data as

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shown in Table 1 indicate that the lowest average rainfall is reported in October, with the average of this month over the twelve year period being 51mm. The months that reported the highest rainfall were July and August with the average for these two months for the twelve year period being 205mm and 255mm respectively.

**Table 1. Rainfall data from 2007 to 2018**

YR	MAY	JUN	JUL	AGU	SEPT	OCT	Average
2018	117.1	94.2	284.5	305.6	117.5	55.8	162.45
2017	179.1	177.8	260.6	259	81.2	32.8	165.0833
2016	97.1	112.2	354.9	148.9	153.2	10	146.05
2015	61.3	95	102.6	283.7	239.8	49.7	138.6833
2014	50.7	71.6	112.2	69.1	193.5	23.2	86.71667
2013	130.2	38.7	133.4	268.3	82	98.6	125.2
2012	154.4	79.3	241.9	128.8	235.1	47.7	147.8667
2011	194.4	147.8	120.4	414.1	142.3	13.9	172.15
2010	154.1	145.2	157	305.5	170.3	133.6	177.6167
2009	70.7	176.7	124.4	234	177.2	72.6	142.6
2008	31.9	120.8	288.1	248.2	169.6	64.2	153.8
2007	92	138.5	284.7	406.4	113.5	13.7	174.8
AVE	111.0833	116.4833	205.3917	255.9667	156.2667	51.31667	149.4181

**Source:** Meteorological Service Department (Manga, 2019)

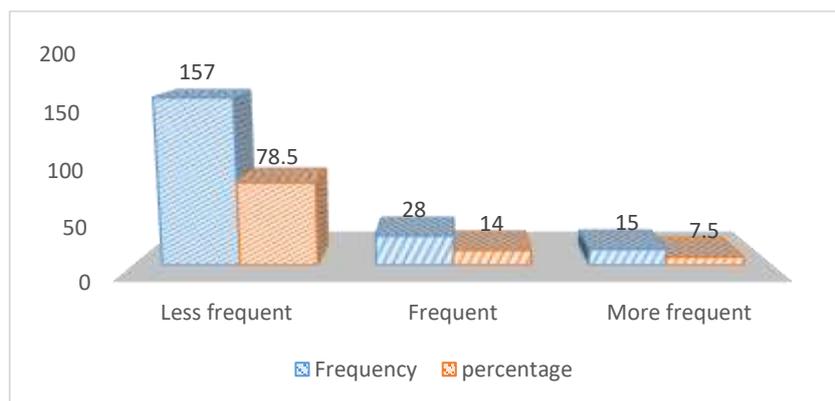
On an annual basis, the records shows that 2010, 2007 and 2017 were years within the twelve months (2007-2018) that experienced the highest rainfall. The lowest rainfall average for a wet season was 2014. More important to these figures is how these rainfall averages translate to flooding, given that rainfall pattern is the major factor known to cause floods. During the interviews with farmers, it was revealed that floods did occur from the beginning of the wet season to the end of the wet season. It was revealed that the floods were more pronounced in places found to be closer to the White Volta.

Further, farmers and key informants interviewed indicated that there were variations in terms of the intensity of the floods for the various months in the wet set season. They mentioned that floods were pronounced from July to October. The floods experienced during July and August is not surprising given that it is the period when rains are heavy as shown in table 1. The floods experienced during October is of great interest here, especially when it is a period when rainfall is less (see Table 1). Explanation for this according to informants was that sometimes, the Bagre dam is spilled during this period and thus accounted for the floods during this period. Further evidence and explanation is provided in the subsequent sections of this chapter.

### Flood occurrence

Discussions with officials from NADMO departments in the two districts indicated that the occurrence of the flood were` an annual phenomena and there was no year without its occurrence. What was however different between now and that of the time before the construction of the Bagre dam is the frequency of its occurrence. Results in figure 1 indicates, a significant number of the respondents were of the opinion that in the past (i.e. before the construction of the dam), even though the floods did occur, it was not as frequent as it is now. Further, in-depth interviews with farmers indicate that flooding has been a challenge that the communities have had to battle with over the years with the intensity varying in accordance with the rainfall within the period, a point which is in synch with a study by Yiran et al. (2016). More important to this point was the worsening of the situation due to the spillage of the Bagre dam which has made the floods a more regular and destructive event.

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**Figure 1: Frequency of floods before the construction of the dam**

Source: Field work (2019)

In addition to the above, it was noted that the annual occurrence of floods had traditional significance as it signified a period that farmers could harvest their crops. This point is noted in one of the responses given by an informant at Sakpari who has lived almost all his life in the community noted that *“the flood used to come towards the end of the season to symbolize that the farming period has come to an end and we will say that the water is looking for its eggs”*. (73 years old man at Sakpari)

A key issue that this quote raises and which further buttresses the point about the impact of the Bagre dam is the point that, flooding was a predictable phenomenon, especially when the communities have lived through this problem and were aware of not just the time but the potency of the flood problem. The additional problem brought by the Bagre dam and its spillage is that it has increased the volume of the floods, and has also made it more regular. This confirm Musah et al (2013) assertion that floods in the northern part of Ghana has increase in magnitude and frequency.

### Spatial coverage and duration of the flooding

From the five communities visited, it was indicated that, the extent of the flooding and its duration has increase as compared to the past years. According to the participants, this is making farming unattractive and life unbearable for them. It was stated that before the construction of the Bagre dam, the floods used to occur within the banks of the river and its valleys which lasted for not more than 24 hours. Participants interviewed explained that, those who used to have their crop destroyed were people who farm in the waterway as well as those who planted late. In recent years, things have change with the construction of the Bagre dam couple with other factors like inappropriate farming practices.

Table 2, shows that most of respondents opined that flood waters have gone beyond the banks of the river stretching more than 1km away. The result thus give credence to the fact that overflow of river bank undoubtedly is a major cause of floods with the spatial coverage increasing with time. The above findings is further corroborated by the qualitative fieldwork were informants shared their perspective on the increasing areal coverage of the floods. An informant during the FGD discussion at Salipiga opine that:-

*“This time round, we cannot tell where the water will get to. Whether you are farming on a hill or a valley, when the Bagre dam is spilled, no one is safe. Sometimes, we don’t even think about the crop again but our own lives. We sleep in turns so that, we can keep watch because we do not know when the water will get to our houses”*

This findings is in synch with the Derbile et al (2016) report which stated that, the erratic rainfall in the Northern Ghana in recent years coupled with the spillage of the Bagre dam has increase the floods situations which is affecting agricultural activities in the area.

**Table 4.3 Extent of the coverage of the flood in recent years**

Distance of flood from the river	Frequency	Percentage
500m from the river	10	5%
800m from the river	1	0.5%
1k from the river	86	43%
Above 1km from the river	103	51.5%

Source: (Field survey, 2019)

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Due to the extent of the coverage of the flood, the end result is usually the increase in the number of days taken by the flood to recede as shown in table 2. The increase in the number of days of the flood consequently leads to the destruction of farm lands which have the potential to cause food insecurity. During such period, farmlands which are submerged in water are either washed away or rotten. This phenomenon according to the respondents is alien to past year's record of floods history in the communities, and it is as a result of the Bagre dam spillage and indiscriminate human activities along the banks of the river.

**Table 2. Showing duration of the flood**

Period of flood	Frequency	Percentage
10 days	13	6.5%
15 days	139	69.5%
More than 15 days	48	24%

Source: Field survey (2019)

### Factors that trigger flooding in the study communities

Floods are very common in the rainy season as the factors that usually trigger its occurrence are prevalent during such period (Wurtermberger et al, 2011). The factors that causes flooding varies from one place to another. In the Northern part of Ghana, heavy rainfall coupled with the spillage of the Bagre dam have been identified as the main causes of flooding in the area (see Forkuo, 2011). Analyses of the data on this phenomenon was done based on respondents' perception about the factors that causes floods among these communities along the White Volta River. From the findings of the study, the causes of floods in the communities were grouped into two base on the perception of the respondents. These were identified as natural causes and human induced causes.

#### Anthropogenic factors

Human factors were cited as another causes of flooding in the area especially in recent years. From the findings, the respondents were of the view that, the construction of the Bagre dam and its subsequent annual spillage is the reason for the increase in the intensity of the floods. As shown in table 3, most of the respondents in the communities visited opine that, since the annual spillage of the Bagre began, there is no year that the floods would not occur in greater magnitude and intensity. They bemoaned that, since the Bagre dam spillage started, they have never had any meaningful harvest that would sustain them for a year especially during years when rainfall is in torrential. Their views were corroborated by newspapers title such as '*Bagre dam spillage: Lives under threat in the North*' (Graphic online, September, 09, 2018), and '*Another Bagre dam spillage: Villagers flee, farms flattened*' (Ghanaian Times, September, 04, 2018).

**Table 3. Multiples response on factors that trigger flooding the study communities**

Factors that trigger floods	Frequency	Percentage
Increase in heavy rainfall	7	3.5
Increase in the spillage of the Bagre dam	180	90
Increase in human activities in the river bank	13	6.5

Source: Field survey (2019)

In focus group discussion in Binduri, the assemblyman explained that, the worst spillage of the dam and its consequent destruction of their farmlands were recorded in the year 2007, 2009, 2014 and 2015 flood. The participants indicated that, the 2007 flood disaster was so severe that, communities which were affected accused the government by then (His Excellency John Agyekum Kuffour administration) of taking bribe and allowing Burkina Faso government to destroy their foodstuffs by spilling the dam. This issue was also raised by Amuquandoh (2016) in his findings on the effect of the annual Bagre dam spillage on Ghana-Burkina Faso relationship. This research could not interrogate further to ascertain how the continuous spillage could possibly affect the peace and security between the two countries due to limited time. This, therefore, calls for research in that regards.

As indicated in table 3, human activities within the catchment area of the river was identified as one of the causes of flooding in the area in recent years. This act has contributed to the occurrence of the flood. During an in-depth interview with 78 years old man, he bemoaned the growing rate of indiscriminate farming and clearing of the vegetation on the banks of the river which were not the practice in past year (see Fig 2). During the field visit and observations, farmland were seen situated very close to the

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banks of the river (see Fig 2.). In almost all the communities visited, the vegetation on the banks of the river which serve as flood protections were indiscriminately destroyed. A respondent explained that, in the past, the banks of the river were covered with trees and creeping plants which made it difficult to identify that there is a river flowing unless you get. He stressed forcefully in a quote that *“in the past, there were certain places in the river side that we don’t farm because such areas were considered the dwelling places of the river gods. However, all these places have been cleared with the assumption that those places are fertile and promotes good yield”*

The buffer zone which serves as a limit with regards to human activities in the catchment area of the river was ignored (see Fig 2.). In an interview with the NADMO Coordinators in both districts, they indicated that, a buffer of 1000m around the river has been designated which forbid any form of farming activities within this zone. However, this was ignored as farmlands were seen in the buffer zone. Because of these inappropriate farming activities both in the dry and rainy season, it has resulted in massive erosion on the banks of the river leading to siltation of the river. This has made the river shallow thereby reducing the volume of water that it can contain. This confirm the issues raised by Agyemang (2013) and Osei (2013) in the conceptual framework on how these indiscriminate environmental practices can contribute to flooding along river channels.



**Fig 2. Nature of human activities on the river**

Source: Field work (2019)

### Sources of food for individual households in the study communities

Food production is one of the important component in assessing food availability for individual households (WHO, 2010). According to the UN (2014), developing countries depend primarily on small scale farming as their main source of food supply. This was the case among all the communities visited. The respondents were of the view that, subsistent farming is their main source of livelihood activity.

As shown in table 4, almost all the respondents indicated that, they obtained their food from the farm. They explained that, this was their main source of food supply. During the FGD, a respondent espoused that his household members in recent years have to resort to purchasing food from market in order to survive.

**Table 4. Source of food supply for household**

Source of food supply	Frequency	Percentage
From the farm	180	90.0%
Purchase from the market	15	7.5%
Food aid from government	5	2.5%

Source: Field survey (2019)

Those who access food from the market (see table 4) complained that whenever they experienced flood, they are not always able to purchase food from the market because of higher prices and limited resources to purchase the food stuff. This is consistent with Boussard et al. (2006) which states that, individuals are food insecure when they lack the resources to access food from the market. This revelation is also supported by Kuwornu et al’s (2011) assertion that, households’ inability to purchase food is likely to lead them into poverty. From the findings of the study, it can be stated that, the survival of the people in these communities

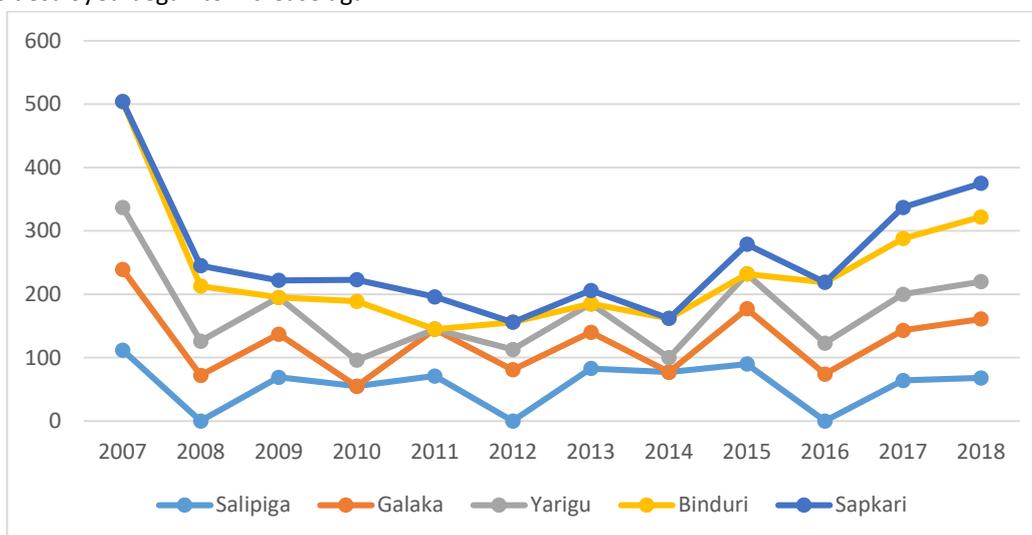
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depend on the produce obtained from the farms with little or ability to purchase food from the market. This mean that, the annual destruction of the farmlands by the flood has the potential to affect food security in the area.

### Levels of destructions of the flood on farmlands

The levels of destruction caused by the flood was examine to ascertain the gravity of the issue under investigation. Respondents were unanimous in terms of the increasing destruction of farmlands by flood waters, and expressed worries that it had consequential impact on food supply for their families. Documents from the NADMO offices in both districts provided additional information to support the claims made by the respondents with regards to destruction of farmlands. The information as provided by NADMO provides details information with regard to the number of acres/hectares of farm land destroyed by the flood.

As indicated from fig 3, it was observed that among all the years reported incidence of flood impact on agricultural activities. However, the destructive year was 2007. Indeed the 2007 flood incidence was so serious that the government declared a state of emergency and had to quickly call for food support from international organizations and NGOs (see Amuquandoh, 2016; Atubiga and Donkor, 2022). Because of the severity of the impact, the year was memorable in the minds of the people as many respondents were found mentioning it during the survey and the FGD. The trend on the destructions of floods indicate that the numbers of farmlands destroyed by the floods over the years has reduced after 2007 with trends remaining the same until 2015 when the number of lands destroyed began to increase again.



**Fig 3. Years of flood occurrence and number of acres destroyed**

Source: NADMO Office (2019)

Discussions with participants during the focus discussions indicate that the mode of destruction of the farmlands by the floods come in different forms. Firstly, during the occurrence of the floods, some crop are always completely submerged in the water. When this happen, the plants would not be able to survive especially when it takes a long time before the water recede (see Fig 4). This confirms Musah et al (2013) assertion that major floods usually result in the washing away of crop or submergence of farmlands.

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**Fig 4.(a) Farmland before the flood (b) Farmland during flood**  
**Source:** Fieldwork (2019)

The second mode of destruction takes the form of complete washing away of the crop. According to the informants, this happens when the crop are still young or ready for harvesting (see Fig 5). In most of the communities visited especially in Yarigu, farmers after harvesting the early maize in the months of July and August would clear the land again and plant crop such as soya beans, beans, groundnuts and tobacco. When the floods occur, these crop are washed away because, at that time, they will either still be in the germination stage or have not developed enough roots to withstand the flood waters. This explanation resonates with WaterAid (2007) and Frederick et al (2010) findings on how farm lands are usually washed away during floods event in the Northern part of the country. In an interview with a farmer who only farm around the river with no other farmlands elsewhere to support his family members laments that: *“when I plant the early maize and harvest them, I sell some and use that money to clear the land to plant beans, groundnuts and soya beans. My households will depend on the maize until these crops are ready in December and we sell them to buy additional maize to supplement us until the next rainy season. But when these crops are destroyed, my households usually suffer food shortage”*



**Fig 5. Farmland washed away by flood**  
**Source:** Field work (2019)

The third mode of destructions by the flood as identified by informants involve causing the food crop to rot. From all the communities visited, the respondents explained that, when matured crops are submerged in the flood water for some number of

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days, they will get rotten (see Fig 6). This information was complimented by the regular visit to the affected farms. It was observed that, the flood normally come at a time when most of the cereal crop are ready for harvesting. When they are submerged for the duration of the flood period, they normally get rotten (see Fig 6). It was noted from an informant that after the flood, such food stuff cannot be used for anything apart from feeding animals and fowls. Again, this assertion is in consonant with Frederick et al (2010) findings on the amount of food items loss every year to flood.



**Fig 6. Rotten crop after flood**

Source: Fieldwork (2019)

### Food production and flooding

From the findings, it was observed that various types of crop were lost every year due to flood. Majority of the respondents were of the view that, since the construction of the Bagre dam, the quantity of foodstuffs that they used to obtain from their farms have decrease drastically. It was indicated that the number of bags an acre of land could produce cannot be said of the same in recent years. A discussant in one of the focus discussion bemoaned the increasing rate of loss of production which is affecting his ability to take care of his household members. This confirms Akudugu et al (2011) view that, the northern part of the country particularly the upper east region has over the years' lost significant amount of food stuff to flood.

The Ministry of Food and Agriculture Director at the Bawku West during an interview indicated that, despite the interventions made by governments in the agricultural sector in the area, food production is still a problem due to the decline in crop yields resulting from decrease in soil fertility and the annual floods. He indicated that, in 2018 alone, the floods destroyed a total of 796 hectares of farmlands of various food crops in the Bawku West District while the Binduri District recorded 923 hectares. With the decline in soil fertility result continuous tilling of the land both in the dry season and rainy season was identified as the main cause. The issue of decline in soil fertility was also raised by AGRA (2013) and Yiran and Stringer (2016) reports on the reduction in crop production in these areas due to insufficient soil fertility as a result of continuous farming.

### Households coping strategies

Coping strategies are usually adopted by households during emergencies to lessen the negative effect of a bad or catastrophic events like food insecurity on their lives (Rose, 2008). These strategies might vary among individual households, and also communities based on cultural and societal values. Nonetheless, the overriding aim of every coping strategy is to reduce the impact of a negative event on individual families and communities. Various coping strategies were adopted by the households in the study communities to respond food insecurity challenges in the area.

From the communities visited, majority of the respondents were of the view that, they are not always able to consume all the produce obtained from the farms during flood free years. This is due to the bumper harvest that they usually get. Many of the respondents indicated that the remaining food stuff are sold in the market to purchase animals (see table 5). These animals are sold in time of need to purchase food. Others stated that the rest are stored for the next season in case there is a decline in production due to the flood. The challenge they face with regard to the storage according to them is pest and insects which usually destroy the foodstuff.

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**Table 5. Various response on the method of consuming the remain food stuff**

Mode of consumptions	Frequency	Percentage
Sell them	111	55.5%
Borrow them to friends	43	21.5%
Store them for next season	46	23.0%

Source: Field survey (2019)

### Alternative source of livelihoods and its sustainability

The issue of alternative source of livelihoods and sustainability was necessary due to the gravity of the destruction of farmlands by the flood as was observed during the analysis process and field observation. During the analysis, many households were found to engage in some agricultural activities in one way or the other that would ensure food security.

Dry season farming was identified as an alternative activity in which the respondents engaged in to survive during the lean season. In all the communities visited, the informants indicated that, they engage in dry season farming to feed their households since their crop are usually destroyed by the floods in the rainy season. Different types of crop were cultivated such as onions, groundnuts, garden eggs, green pepper, and cabbage. These crop are sold and the proceeds are used to purchase food. This activity also has its own challenges as the respondents complained that they do not have enough resources to engage in large scale farming. A 57 year old man a focus discussion in Galaka lamented that:-*"we do not have money to buy water pumping machines to irrigate the crop in the dry season. This has made it difficult for us to engage in large scale farming.* Also, some women were also into other livelihood activities to support the household heads to feed the family. Some of the include pito brewing, rice processing and dawadawa making. They noted that the profit made are used to purchase food to feed their family members. The pito brewers complained that, with the emergence of the floods and the decline in the cultivation of guinea corn and sorghum, their businesses are at the verge of collapsing since they do not have resources to travel to Burkina Faso to buy guinea corn for the preparation of the pito. The same thing was said by those who engaged in rice processing.

The issue of obtaining assistance from government and other agencies during the flood event was also explored. As shown in table 6, majority of the respondents stated that, sometimes, the items that are given to them are woefully inadequate as compare to what is loss to the flood. A respondent retorted that, the items usually given to them have no correlation with their food items loss to the flood. He asked the rhetorical question "how can I survive with blankets, plastic buckets, and mattresses when I have lost all crop? From the discussion, it was noted that, in most cases the items are given to the ruling government faithful to the detriment of the majority of the people who have had their farmlands destroyed. Few of the respondents however, mentioned that the items given by the government are adequate as compare to what they have loss to the flood.

**Table 6. Multiples response on aid from NADMO in the study communities.**

Assessment of NADMO support	Frequency	Percentage
Adequate	2	1.0%
More than adequate	8	4.0%
Inadequate	79	39.5%
Woefully inadequate	109	54.5%

Source: Field survey (2019)

### CONCLUSION AND RECOMMENDATIONS

The study contributes to the body of knowledge by evaluating the perennial flooding on the White Volta River and the Bagre dam spillage on agricultural activities in the Sudan Savannah in the UER, Ghana. The findings showed that flood was and has not been something new in the communities. However, what seems to be the problem is the extensiveness of the floods, the spatial coverage and the debilitating impact on food supply. The study revealed that the annual spillage of the Bagre dam coupled with torrential rainfall was the main factor influencing the annual occurrence of the floods in the communities. As a result several farmlands and animals have been destroyed by the floods with the most destructive recorded in 2007. In terms of coping strategies, a range of coping strategies are employed by households and include selling animals, reducing food taken and engaged in minimal works. Based on the finding, the following recommendations were made:

- The study calls for government support for NADMO as an institution in charge of public sensitization against disaster events and also relief distribution. This will help minimize the impact of the flood on the farmers.

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- The study recommend that there is the need for intensive measures to be taken such as technical, economic and institutional strategies to mitigate the impact of the flood on food production.
- Again, it is recommended that there should be close engagement between authorities in Ghana and that of Burkina Faso so that the latter country can provide exact time for the spillage of the dam. Information on the dam spillage beforehand will help farmers in the affected communities to adequately prepare, including early harvesting to reduce the amount of farm produce lost to floods.

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### AUTHOR'S CONTRIBUTIONS

All the authors contributed to carry out the study.

### ETHICS

The study maintained high level of integrity, transparency, and confidentiality and there is no conflict of interest to be declared.

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